

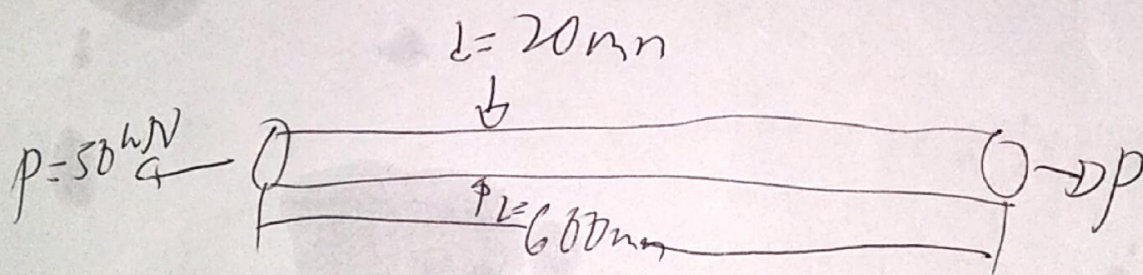
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A solid circular rod of length 600 mm and 20 mm in diameter is subjected to an axial tensile force of $P = 50\text{ kN}$. The elongation of the rod is $\delta = 1.40\text{ mm}$ and its diameter becomes 19.9837 mm . Determine the modulus of elasticity E and the modulus of rigidity G of the material. Assume that the material behaves elastically.

Solution:



$$L = 1.40\text{ mm}$$

$$L_f = 19.9837\text{ mm}$$

find: E, G

$$\Delta L = 19.9837\text{ mm} - 20\text{ mm} = -0.0163\text{ mm}$$

$$\sigma = \frac{P}{A_\sigma} = \frac{50000}{\pi \left(\frac{20}{2}\right)^2} = 159.1545 \text{ MPa}$$

$$\tau = \frac{-P}{A_\tau} = \frac{-50000}{2\pi \left(\frac{20}{2}\right)(600)} = -1.3263 \text{ MPa}$$

$$\epsilon = \frac{\delta}{L} = 2.3333 \times 10^{-3}$$

$$\gamma = \frac{\Delta \downarrow}{\downarrow} = -815 \times 10^{-6}$$

$$\sigma = E \epsilon \Rightarrow E = \frac{\sigma}{\epsilon} = 68210.2173 \text{ MPa}$$

$$\tau = G \gamma \Rightarrow G = \frac{\tau}{\gamma} = 1620.3626 \text{ MPa}$$

$$E = 68.21 \text{ GPa}$$

$$G = 1.62 \text{ GPa}$$